TAKE-ALL AND FLAG SMUT

TWO WHEAT DISEASES NEW TO THE UNITED STATES

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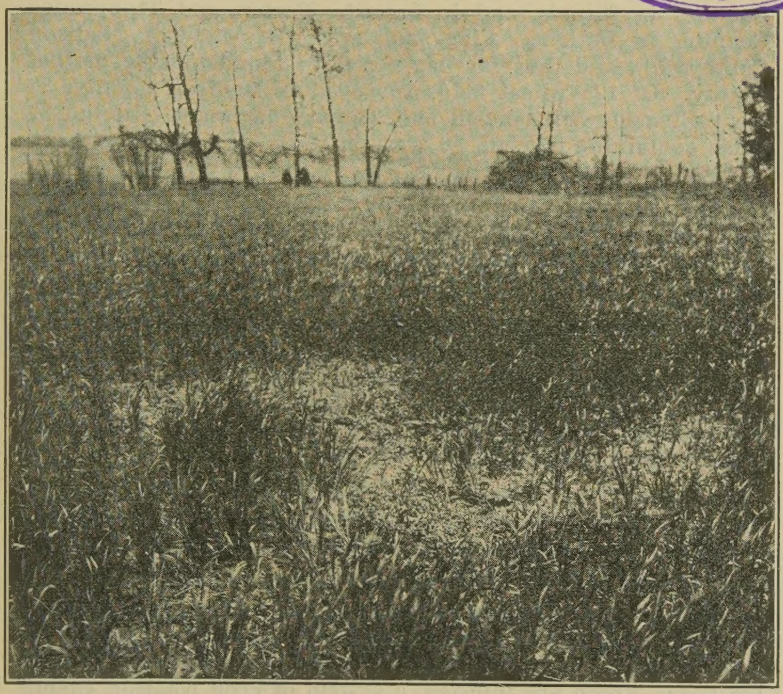

A Spot in a Wheat Field Infested with Take-All, Showing Dead and Diseased Plants

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TWO IMPORTANT WHEAT DISEASES, take-all and flag smut, have recently been discovered in the United States. This take-all, if not identical with that of Australia, is strikingly like it in the effect it produces on the growing crop. Flag smut is the same disease that occurs in Australia, India, and Japan.

Take-all has been found in Madison, Sangamon, and Mason Counties in Illinois, and in Laporte, Porter, and Tippecanoe Counties in Indiana. Flag smut was discovered in Madison County, Ill., and thus far has not been found outside of that county. Of 121 wheat fields surveyed in Madison County, 32 were affected with take-all and 23 with flag smut. Of the 32 fields containing take-all, 10 were affected also with flag smut.

To learn whether take all and flag smut had been introduced through the use of Australian-grown seed, an investigation was made and the source of the seed wheat used in each of the diseased fields was determined. None of the wheat was of Australian origin.

In the field take-all is recognized by the appearance of more or less irregular patches of stunted and dying plants. The most seriously diseased plants are of a dull bluish green color at first, but later turn brown and die. All affected plants show in varying degrees a rotting of the roots and a brown decay of the stems at the surface of the ground.

Flag smut differs from the other wheat smuts in that it attacks the leaves. In the later stages of this disease the flag leaf and its sheath, or boot, become twisted and much distorted. Smutted plants rarely produce heads.

Until more is known concerning the cause of take-all in America, complete recommendations for its control can not be made. Grain from infected fields should never be used for seed. On farms which are infested, a system of crop rotation should be used which keeps wheat, oats, barley, and rye off the land for four or five years. These measures should effectively control the disease.

Flag smut can be controlled by crop rotation combined with seed treatment, as recommended in this bulletin.

TAKE-ALL AND FLAG SMUT, TWO WHEAT DISEASES NEW TO THE UNITED STATES.

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DISCOVERY OF TAKE-ALL AND FLAG SMUT IN THE UNITED STATES.

TWO SERIOUS DISEASES of wheat, hitherto unknown in this country, have been discovered recently in Madison County, Ill.[1] The first is apparently identical with the well-known take-all, or white-heads, of Australia and Europe. The second is flag-smut of wheat, also common in Australia and known in Japan and India. Immediate measures were taken by several of the States, in cooperation with the United States Department of Agriculture, to determine the distribution of these two diseases and the damage caused by them. The reports received thus far (July 25, 1919) show that take-all is confined to Illinois and Indiana. Flag smut has been discovered only in Madison County, Ill., where it was found in a number of the fields infested with take-all.

The presence of take-all was discovered through a report from the county agent of Madison County, stating that wheat near Granite City, Ill., was being seriously injured by some disease. A prompt investigation of the reported trouble was made by representatives of the Illinois Agricultural Experiment Station, and the United States Department of Agriculture. It was subsequently arranged to bring together in Madison County a representative number of plant pathologists, to enable them to acquaint themselves with take-all by a personal inspection of the diseased fields.

These conferences, attended by pathologists from many other States and by representatives from the United States Department of Agriculture, were held at St. Louis, Mo., and in Madison County, Ill., on May 5, 6, 12, and 13, 1919. On May 5, immediately on entering the fields in which take-all had first been found, Mr. J. G. Dickson, of the Office of Cereal Investigations, discovered flag smut in one of them. Later in the same day this smut was observed in a number of fields.

[1] Take-all, or white-heads, as known in Australia, is caused by a sac fungus (*Ophiobolus graminis* Sacc.). Flag smut is caused by one of the true smuts (*Urocystis tritici* Koern.).

In most of them only a slight infection was noted, while in others it ran as high as 1 to 2 per cent in certain spots.

This preliminary survey covered 4,067 acres, or a total of 121 fields. Of these, 32 were found affected with take-all and 23 with flag smut. Of the 32 fields infested with take-all there were 10 in which flag smut also was found, indicating the possible introduction of these diseases on seed of Australian origin. The fact that since December, 1917, nearly 5¼ million bushels of Australian-grown wheat had been unloaded at the six American ports of Los Angeles, San Francisco, Portland, Seattle, Baltimore, and New Orleans was cause for concern. The origin of the seed used by the Illinois farmers was carefully looked into by Dr. C. E. Leighty, of the Office of Cereal Investigations. The results so far are wholly negative; in fact, there is no evidence that any of the wheat shipped to this country from Australia was used for seed. We are, therefore, still in the dark as to the manner in which take-all and flag smut found their way into the United States.

During the week ended May 10, 1919, a survey of fields reported diseased in Indiana was made by representatives of the Indiana Agricultural Experiment Station and the Office of Cereal Investigations of the United States Department of Agriculture. As a result of this prompt action, Indiana reported at the second St. Louis conference that take-all had been found in three counties of that State—Laporte, Porter, and Tippecanoe. Since that date the disease has been discovered also in Sangamon and Mason Counties in Illinois.

LOSSES CAUSED BY TAKE-ALL AND FLAG SMUT.

All who have seen fields infested with take-all are agreed that the disease is properly named and that it is a serious menace. The illustration on the title-page, from a photograph by G. N. Hoffer, of the Indiana Agricultural Experiment Station at La Fayette, Ind., shows a typical spot in a wheat field infested with this disease. It should be pointed out, however, that neither take-all nor flag smut has ever been reported to cause losses comparable to those resulting from certain epidemics of black stem rust in this country. These two diseases may result in considerable damage to the wheat of individual farmers this year, but the indications now are that such losses will not be sufficient to produce any appreciable effect on the total production of wheat in 1919.

Three points should be emphasized: (1) Take-all and flag smut have appeared in this country, (2) they are serious diseases, and (3) measures must be taken to stamp them out. The annual loss due to long-established cereal diseases already amounts to many million bushels of wheat alone. In exceptional years, such as 1916, the loss may have exceeded 200,000,000 bushels. And now we are facing the possibility of even greater tolls being taken.

Take-all and flag smut are recent arrivals among the pests of American wheat fields. They have not yet become widespread, and

by prompt action to prevent the distribution of seed wheat from infested farms an exceedingly important step will be taken toward their successful control.

TAKE-ALL.

It has not yet been determined that the take-all of American wheat fields is caused by the same parasitic fungus as that causing take-all in Australia. The European take-all seems to differ somewhat from the Australian; but our knowledge of the cause or causes of the disease known as take-all in different parts of the world is far from complete.

SYMPTOMS OF TAKE-ALL.

The symptoms of this disease as found in the Illinois and Indiana fields are strikingly like those of Australian take-all. In fields but

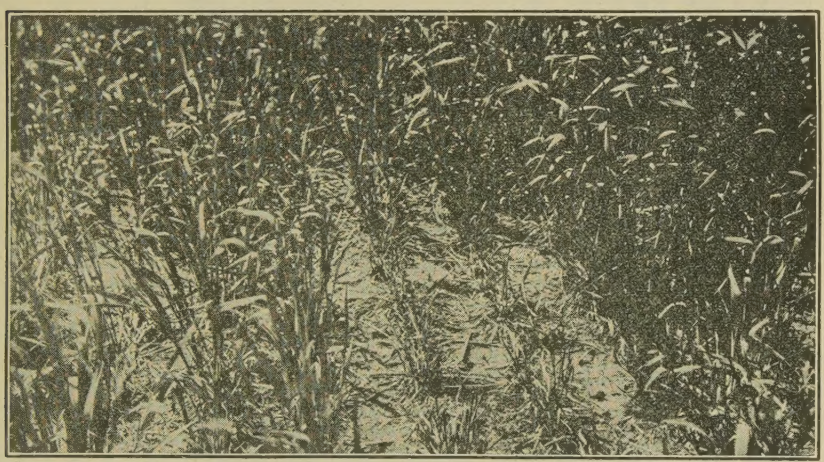

FIG. 1.—Portion of a spot in a wheat field infested with take-all.

slightly infested distinct patches of badly dwarfed plants show up here and there, without regard to soil type or condition. (Fig. 1.)

The plants in these patches, if not killed outright by the disease, take on a characteristic bluish green color, in striking contrast to the normal green of healthy wheat plants. Such patches vary in diameter from 3 or 4 feet or less to 70 feet or more and are of irregular shape. Later, these dwarfed diseased plants dry up and die. (Fig. 2.)

In the most seriously diseased fields scarcely any patches are seen, because the infestation is so general as to include almost the entire area. In such fields many of the plants are killed by the take-all early in their development. Plants less seriously infected remain rosettelike in appearance, being just low clumps of leaves. In their struggle against the disease they send up weak, more or less spindling sprouts or suckers with sickly, slender leaves. Diseased plants are but weakly rooted. The roots become badly rotted and the stems at the surface of the ground turn brown. In advanced stages of take-all the plants become rotten at the base—a condition which has suggested the name foot-rot, by which the disease is sometimes

known. Affected plants may survive the early or seedling attack and produce heads. These heads, however, may never fill but become white in color, thus suggesting the name "white-heads" sometimes given to this disease.

FIG. 2.—A normal, healthy wheat plant (at the left) and two plants badly affected with take-all (at the right).

FLAG SMUT.

According to the published reports dealing with flag smut, this disease seldom causes damage amounting to as much as half the stand of any given field. Compared with bunt or stinking smut it is of secondary importance. But in Australia losses equaling 10 per cent are common, and larger losses have frequently been noted. The important thing to remember is that flag smut, like the stem smut

of rye, if allowed to go unheeded, probably will grow steadily more destructive, for the very resistant spores are easily capable of surviving in the soil.

FIG. 3.—Portions of infected wheat plants showing flag smut in the leaves.

SYMPTOMS OF FLAG SMUT.

Flag smut is easily recognized by the long, narrow stripes on the leaves. (Fig. 3.) At first these stripes are bluish green or lead color, and later they become black. This disease is called flag smut because it is especially noticeable on the uppermost or flag leaf. It differs distinctly from bunt of wheat, on the one hand, and loose smut, on the other, because it attacks the leaves, while they attack the heads

and kernels. The flag smut of wheat (*Urocystis tritici*) resembles closely the stem smut of rye (*Urocystis occulta*). Like the rye smut it attacks the leaves and occasionally the stems of affected plants. Rye smut, commonly known as stem smut, may not destroy all the stems of a plant, and this is occasionally true of flag smut of wheat also. Usually, however, all the stems of a smutted wheat plant are destroyed.

In the later stages of the development of flag smut the flag leaf and its sheath, or boot, become twisted spirally, so that the heads can not come out. The infected plants dry up prematurely without producing heads.

CONTROL OF TAKE ALL AND FLAG SMUT.

Until more is known concerning the cause of take-all in America, complete recommendations for its control can not be made. Grain from infected fields should never be used for seed. On farms which are infested a system of crop rotation should be used which keeps wheat, oats, barley, and rye off the land for four or five years. These measures should effectively control the disease.

The control of flag-smut has been studied considerably by Australian workers. This disease results from the seedling becoming infected before the young wheat plants appear above ground. It can be controlled by seed treatment. The problem of control, however, is somewhat complicated by the fact that infection may result from spores already present in the soil or on old straw or other refuse previously worked into the soil. Indeed, the control of flag smut presents problems similar to those met in the control of bunt or stinking smut in the Pacific coast section, where soil infestation occurs and where the practice of summer fallowing is followed.

No amount of seed treatment can result in the prevention of flag smut unless that treatment is combined with a proper system of crop rotation. Just how long the spores of flag smut can survive in the soil under normal conditions is yet to be determined. It is probable, however, that a 3-year rotation will suffice. This smut is known to infect wheat only, and can not, as many believe, produce the similar smut in rye. Australian authorities recommend the use of bluestone in treating seed for the prevention of flag smut. The stem smut of rye, which resembles very closely the flag smut of wheat, is easily prevented by the application of formaldehyde at the rate of 1 pint to 40 gallons of water. It is probable that the same solution applied for a period of 10 to 30 minutes would prove effective in killing any seed-borne spores of flag smut. The safest procedure, however, is to use for seed only wheat from clean fields.

Further studies in the control of flag smut will be made during the coming fall and winter and continued later. Meantime every measure possible should be taken to prevent the use for seed purposes of any wheat coming from localities where flag smut is known to occur.